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CURRENT USSR THEORIES ON ACTION OF CHEMICAL MEDIATORS IN TRANSMISSION OF NERVE IMPULSES

B. I. Zbarskiy, I. I. Ivanov,
S. R. Mardashev

The irrigation of parasympathetie nerves or of motor nerves results in the liberation of acetylcholine, while the irritation of sympathetic nerves induces liberation of sympathins. The sympathins comprise a system which consists of adrenaline and of products of the transformation of adrenalin (A. M. Utevskiy). Excitation of the central nervous system and of sympathetic ganglia is also accompanied by the liberation of acetylcholine (K. M. Bykov, A. V. Kibyakov).

Accordingly, one distinguishes between cholinergic nerves and adrenergic nerves, depending on the type of substances which bring about the transmission of impulses at peripheral synapses (the points of contact of nerve endings with various organs) or at synapses through which the connection between individual nerve cells is affected.

In addition to acetylcholine and adrenalin-like substances (sympathins), histamine is also assumed to play a definite role in the transmission of nerve impulses, specifically the transmission of these impulses in sensory nerves. Since the chemical mediators mentioned above play a substantial role in the propagation of nerve stimulation and the transmission of impulses to effector tissues, an investigation of the synthesis and decomposition of these substances, which are very labile compounds of a definite chemical structure, is of great importance to an understanding of the mechanism of the transmission of nerve impulses.

Acetylcholine, which is the acetic acid ester of choline, is synthesized in tissues with the aid of the special enzyme, choline-acetylase. The synthesis of acetylcholine in nerve tissue takes place under the participation of glucose. The decomposition of the latter furnishes both acetyl groups and the energy which is necessary for the formation of adenosine triphosphate. The adenosine triphosphate brings about phosphorylation of intermediate products which are necessary for the synthesis of acetylcholine.

The decomposition of acetylcholine into acetic acid and choline is brought about by another enzyme, which has received the name of cholinesterase.

Acetylcholine and the specific cholinesterase are not distributed uniformly in the nervous system. For instance, the gray matter of the cerebrum contains (referred to dry matter) 1.39 mg % of acetylcholine and (in relative units) 10.8 units of cholinesterase, while the cerebellum contains 0.37 mg % of acetylcholine and only 5.6 units of cholinesterase (P. A. Kometiani). Usually, an increased content of choline-acetylase is found wherever acetylcholine is synthesized at a relatively rapid rate. The normal transmission of impulses by cholinergic nerves depends not only on the rate of synthesis and liberation of acetylcholine (which, to some extent, occurs in a bound state in nerve tissue), but also on the rate of its decomposition by hydrolysis. It is obvious that the activity of cholinesterase is of great importance in this connection.

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The interrelationship between the synthesis of acetylcholine and its liberation from the state of combination with proteins, on the one hand, and the enzymatic decomposition of acetylcholine under the action of cholinesterase, on the other hand, is of great importance to the functioning of cholinergic systems. When the cholinesterase is inhibited by specific agents such as physostigmine or neostigmine, the activity of parasympathetic nerves is strongly stimulated. For that reason, substances of this type are used in medicine.

Kh. S. Koshtoyants has advanced a hypothesis according to which specific products of metabolism within the nervous system function as transmitters of nerve impulses. According to Koshtoyants, these products are effective in transmitting impulses because they participate in the chain of chemical transformations which form the basis for the functional manifestations of innervated organs. For instance, in the transmission of impulses to striated muscles, the acetylcholine cycle is connected with the cycle of transformations of adenosine-phosphoric compounds.

Kh. S. Koshtoyants found that the sulfhydryl (HS-) groups of proteins participate in the transmission of nerve impulses. The transformation of HS- groups into -S.S- groups elimates the so-called vagus effect on the heart, which is expressed in stoppage of the heart under the action of the vagus and also counteracts the stoppage of the heart produced by an artificial introduction of acetylcholine. When the sulfhydryl groups have been blocked chemically, a number of reflex reactions does not take place. These reactions are restored when the sulfhydryl groups have been liberated.

Acetylcholine is a substance that is very active biologically: it affects various biochemical processes when present in extremely small concentrations (Kh. S. Koshtoyants, P. A. Kometiani).

The bioelectric currents which accompany the excitation of nerve elements and of muscles are also closely connected with metabolic phenomena, particularly the act[illegible] chemical mediators.

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